A Look Back at the Historical Nimbus 7 Nonscanner Radiation Budget Record

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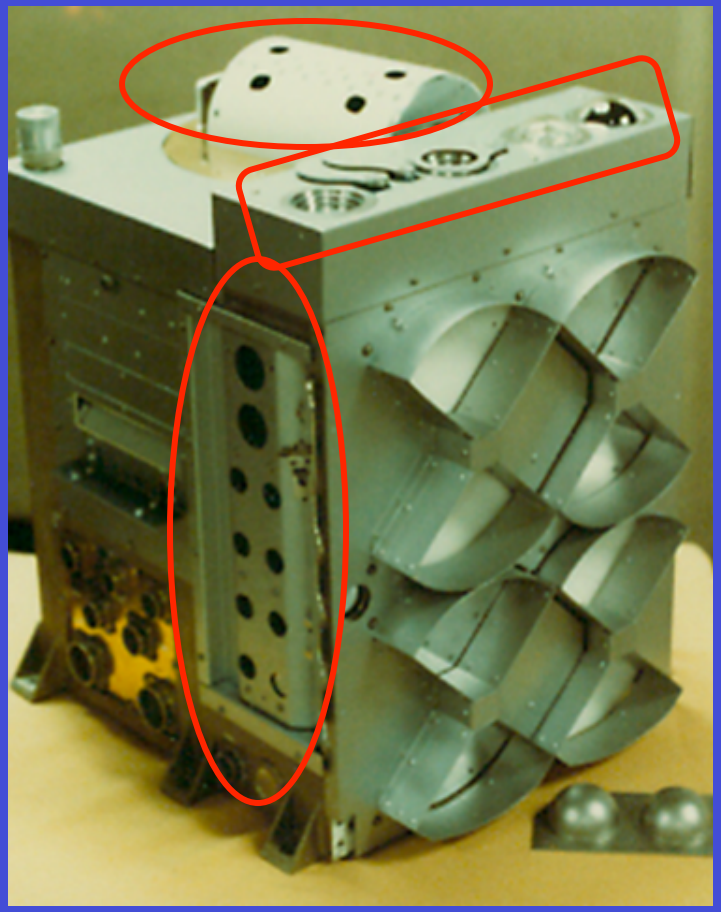
Outline

- Nimbus 7 satellite
- Nimbus 7 ERB instrument package
- Nimbus 7 ERB nonscanner monthly mean data record
- Nimbus 7 nonscanner and ERBE (ERBS+NOAA9) scanner comparisons

Nimbus 7 Satellite

- Nimbus 7 satellite was launched into orbit on 10/24/1978
  - satellite altitude: 955 km altitude
  - orbit type: sun-sync
  - equatorial crossing time: noon
- Nimbus 7 mission included numbers of different instrument payloads
  - SAMS and SAMS II (Aerosol)
  - SBUV/TOMS (Ozone)
  - CZCS (Ocean Color)
  - LIMS (Chemistry)
  - THIR (Temperature/Humidity)
  - SMMR (Microwave)
  - **ERB (Earth Radiation Budget)**
- Nimbus 7 satellite retired in 1995 after 16-year of service

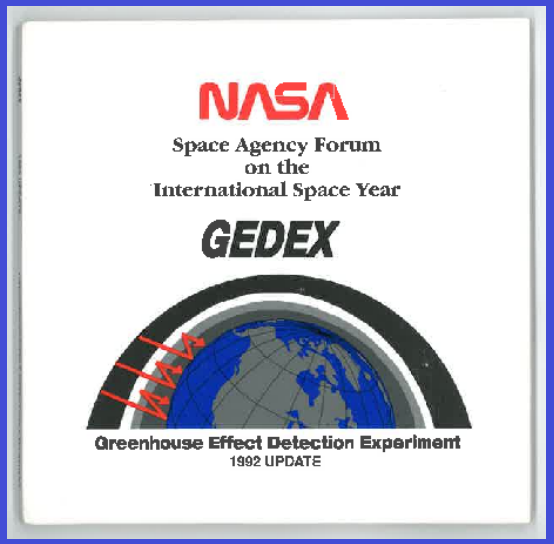
Nimbus 7 ERB Instrument Package



- The Nimbus 7 ERB package contained
  - a set of spectral and broadband solar irradiance monitoring sensors (thermopile detectors)
  - a set of broadband scanning narrow-field-of-view sensors (pyroelectric detectors)
  - a set of broadband non-scanning wide-field-of-view sensors (thermopile detectors)
- Nimbus 7 ERB nonscanner instrument sensors included both broadband total and broadband shortwave channel
- Stability: Monitoring BB temperature (Total) and viewing the Sun (SW)
- Nimbus 7 ERB nonscanner provided a 9-year calibrated earth radiation budget record of from 11/1978 to 10/1987

Nimbus 7 Monthly Nonscanner Data Record

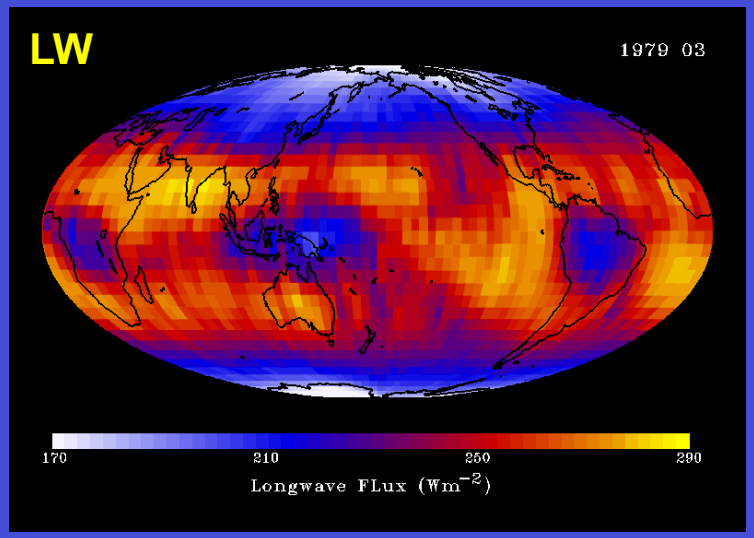
- The official Nimbus 7 monthly mean nonscanner data record is produced by Nimbus 7 ERB instrument team
- The entire 9-year of nonscanner monthly data record is stored in a single Nimbus 7 ERBMATRX data file (~22 Mbytes) in CDF format
- ERBMATRX data is available on the NASA GEDEX CD-ROM (NASA GSFC, 1992) and online (google search “erbmatrx.cdf”)

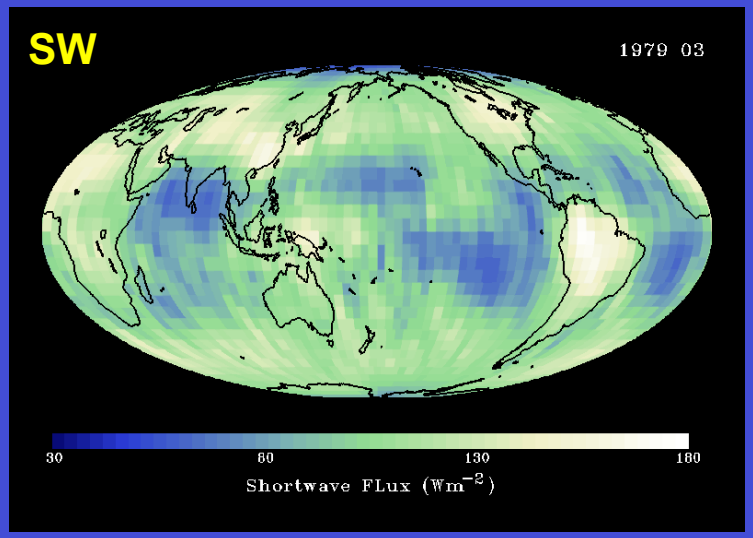


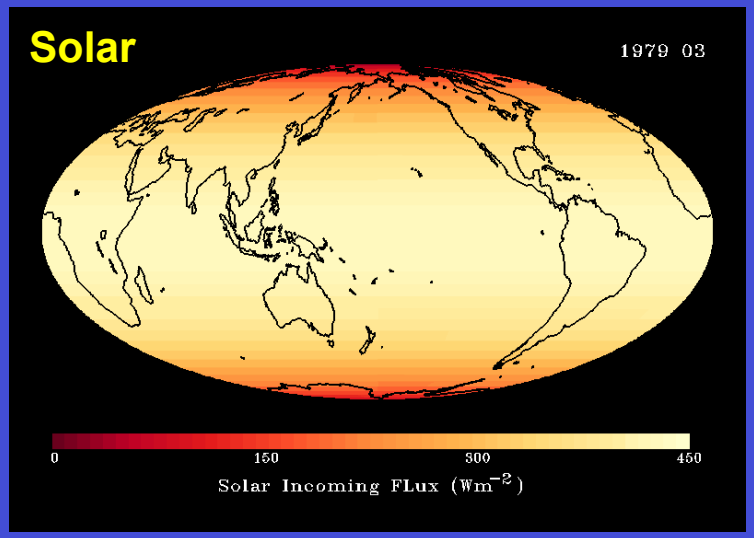
Nimbus 7 Monthly Nonscanner Data Record (cont.)

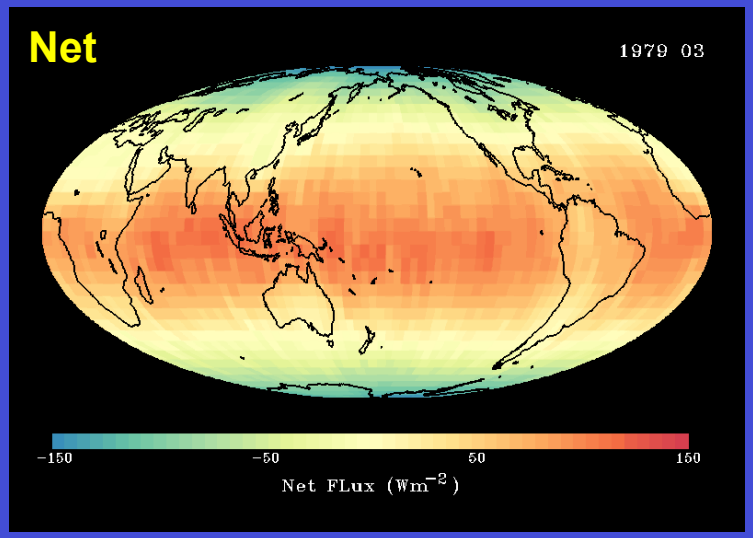
- The monthly mean data is on a 4.5-degree equal-area grid; ranging from 3 grid points at the poles to 80 grid points at equator; a total of 2070 regions on a global map
- The monthly mean data is available from 11/1978 to 10/1987 with one missing data month for 5/1986
- Monthly mean data for 11/1978, 4/1986, and 6/1986 are based on partial month data
- ERB variables: Albedo, Longwave, Solar Incoming, and Net radiation
- Shortwave can be calculated from Solar - longwave - net
- All sky data only, no clear-sky variables

Nimbus 7 Nonscanner Data: March 1979



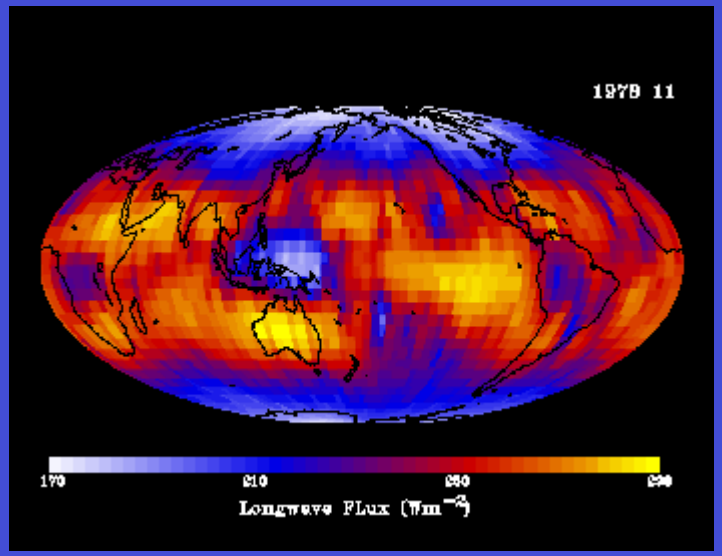




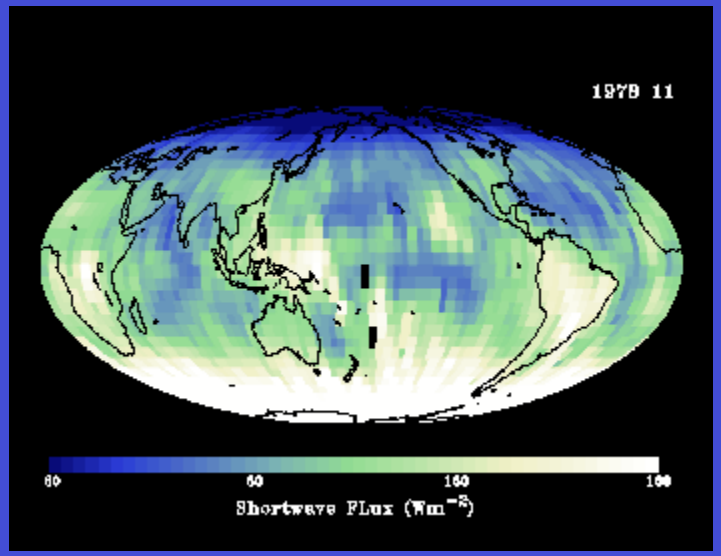


Nimbus 7 LW, SW, Net: 11/1978 to 10/1987

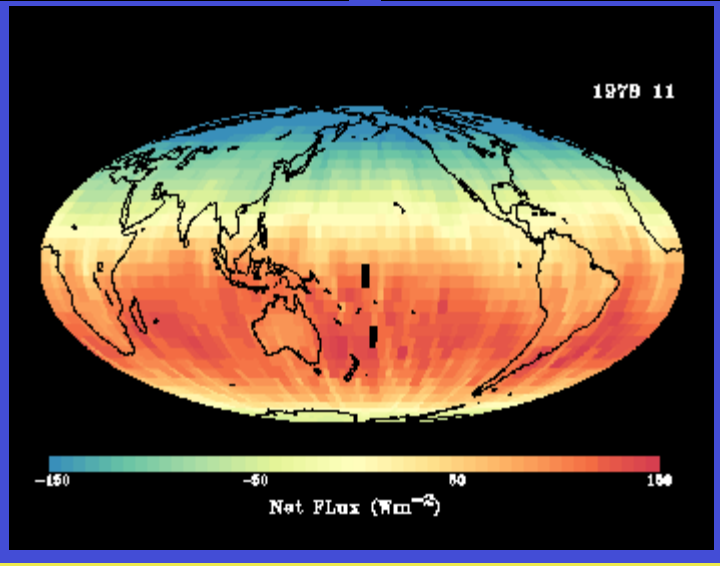
LW



SW

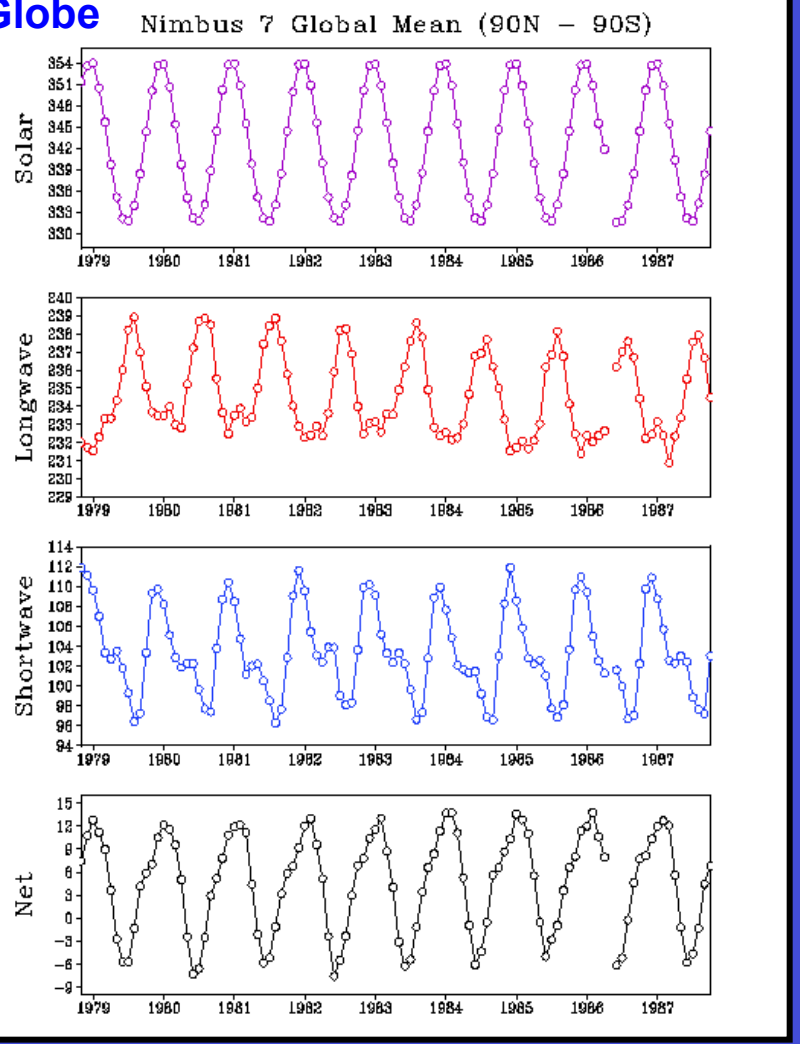


Net

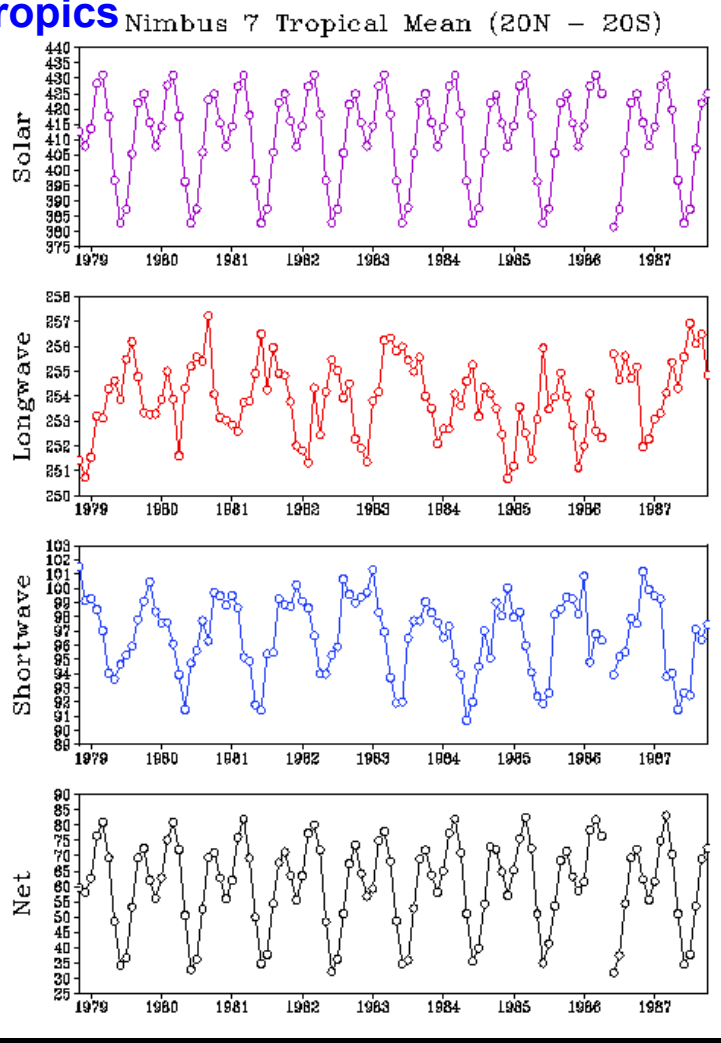


Nimbus 7 Global and Tropical Mean Time Series

Globe



Tropics



Nimbus 7 Global and Tropical Mean Summary

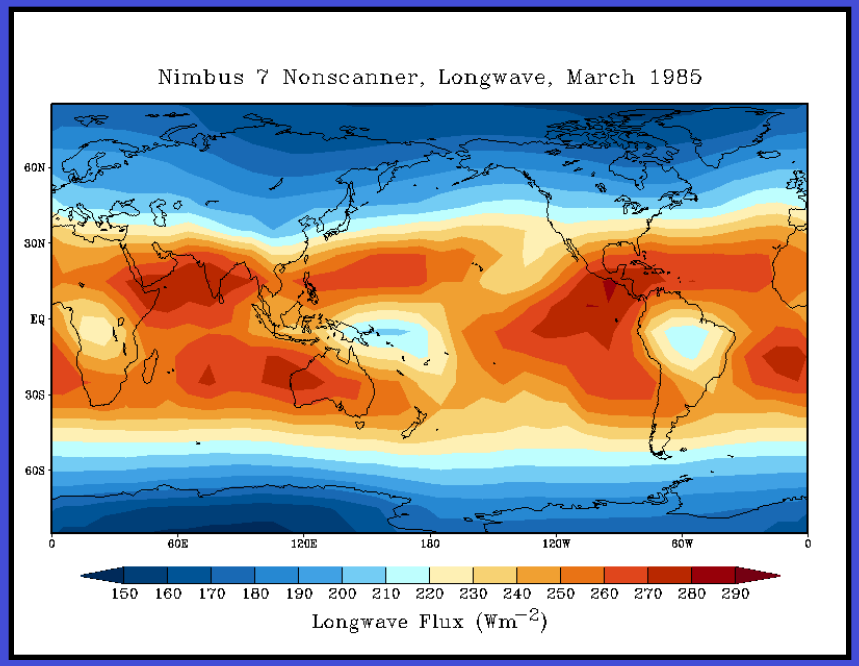
	Globe (90N-90S)		Tropics (20N-20S)	
	Mean (1980-85)	Interannual Variability	Mean (1980-85)	Interannual Variability
Solar	342.48	±0.03	411.15	±0.08
LW	234.67	±1.16	253.87	±1.37
SW	103.31	±0.76	96.62	±1.23
Net	4.50	±1.22	60.65	±1.77

- Nimbus 7 solar constant ~ 1370, much higher than the SORCE's value of 1361
- Nimbus 7 record has a positive global net imbalance of 4.5 Wm^{-2}
- Nimbus 7 global mean albedo ~ 30.16%
- EBAF 2.8 Global: Solar~339.8, LW~239.6, SW~99.6, Net~0.59

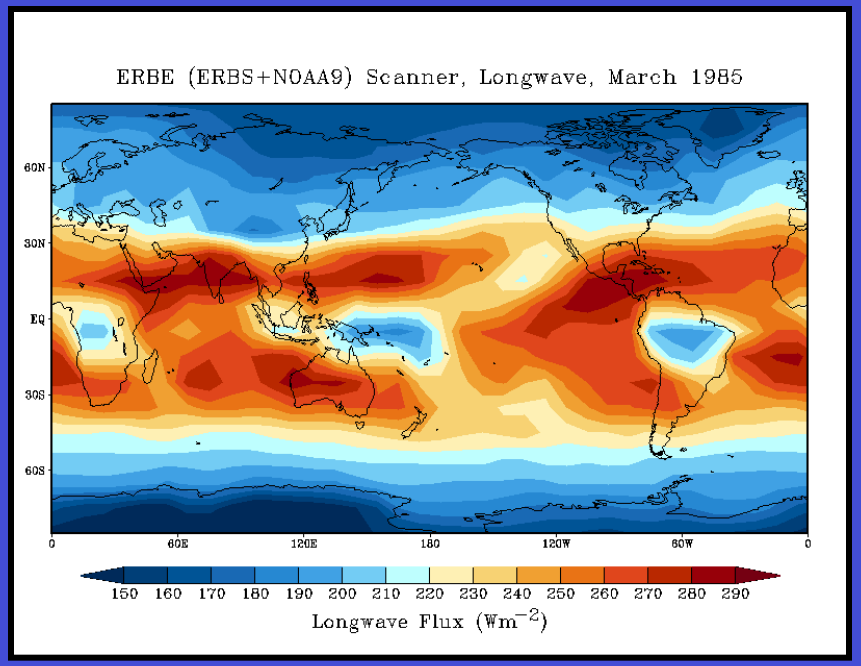
Nimbus 7 and ERBE Regional Comparisons

- Regrid Nimbus 7 data onto the ERBE 10-degree equal-angle grid
- Compare with ERBE (ERBS+NOAA9) scanner 10-degree data
- Overlap period: One year from 2/85 to 1/86

Nimbus 7 Longwave



ERBE Longwave

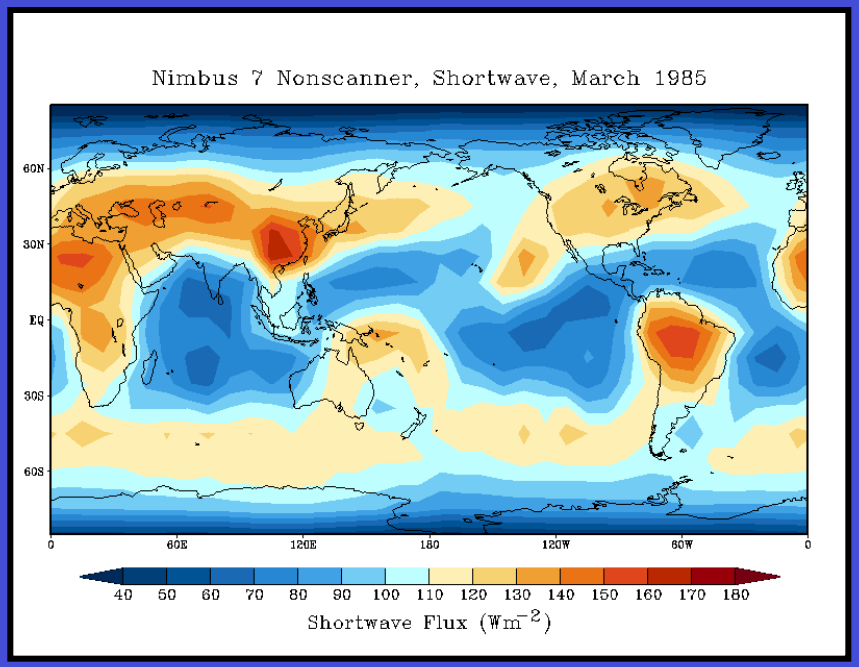


Correlation Coefficient = 0.974

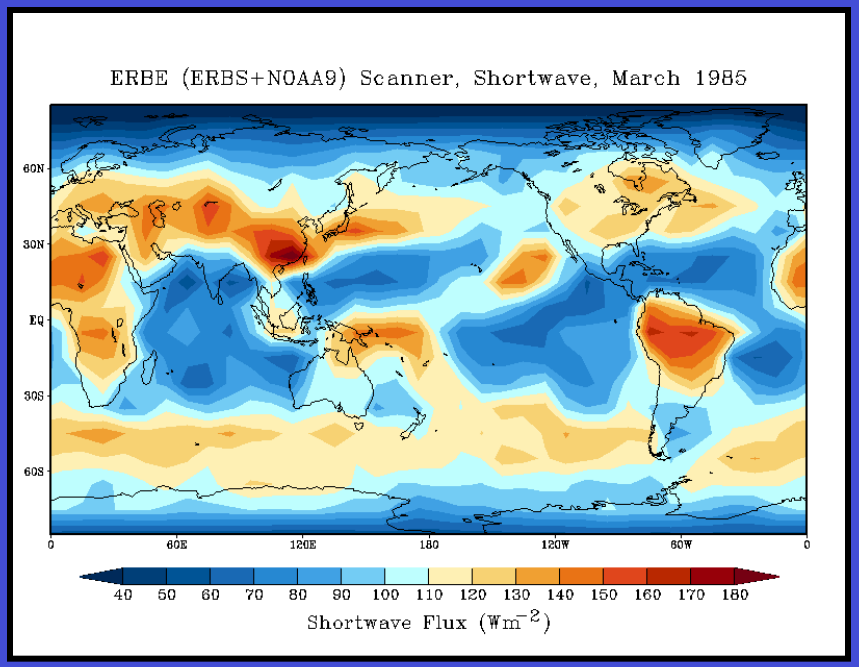
Nimbus 7 and ERBE Regional Comparisons (cont.)

- Nimbus 7 and ERBE patterns (LW, SW, Net, Solar) are very similar; correlation coefficient from 0.931 to 0.999
- ERBE data seems to have a larger regional dynamic range

Nimbus 7 Shortwave



ERBE Shortwave



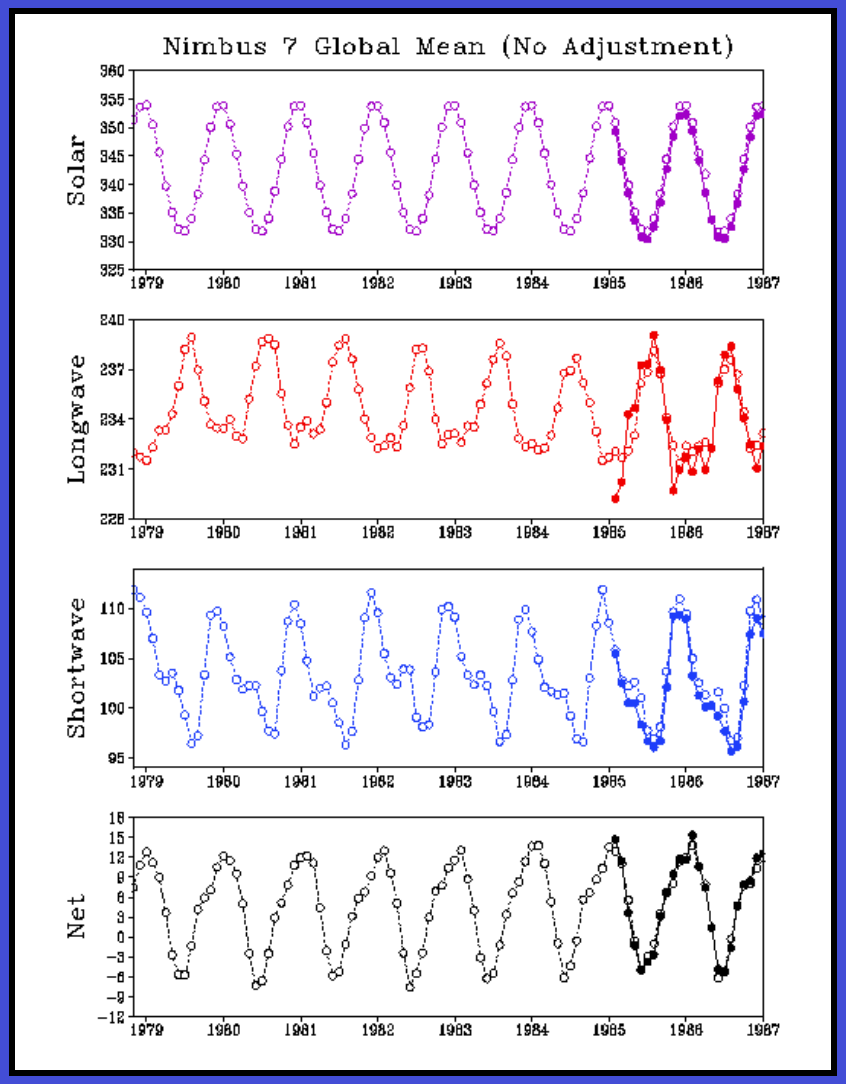
Correlation Coefficient = 0.937

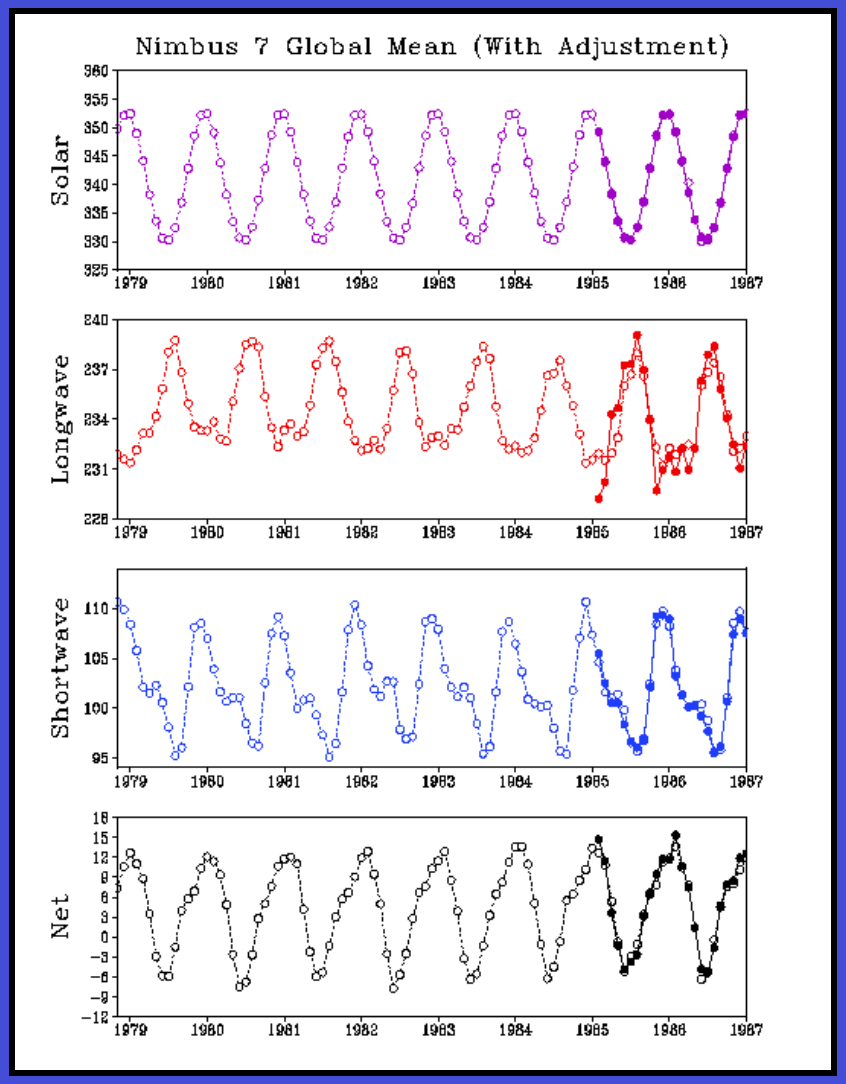
Global Mean (90N - 90S) Overlap Results

	ERBE (2/85-1/86)	Nimbus 7 (2/85-1/86)	Nimbus 7 - ERBE	
			Bias	RMSD
Solar	340.95	342.48	1.53	1.53
LW	233.77	233.93	0.16	1.54
SW	102.19	103.41	1.22	1.42
Net	4.99	5.14	0.15	1.07

- Nimbus 7 global means are higher than the corresponding ERBE values during the 1-year overlap period
- The largest bias is in the solar insolation due to usage of different solar constant value
- The LW and Net have small mean bias; but the large RMSD

Nimbus 7 Adjusted Global Time Series





Summary

- Discuss the Nimbus 7 satellite mission (orbit and instruments)
- Provide information on the Nimbus 7 ERB instrument package
- Discuss the Nimbus 7 ERB nonscanner monthly mean data product (data availability, data format, spatial resolution and temporal period, variables, missing data)
- The 9-year (11/1978 to 10/1987) Nimbus 7 nonscanner data record appears to be in good quality with minor data issues
- Regional patterns (LW, SW, Net, and Solar) are very similar between Nimbus 7 and ERBE; correlation coefficient > 0.931
- Nimbus 7 global mean are higher than ERBE during the 1-year overlap period
- Global mean bias adjustments are used to tie Nimbus 7 nonscanner global mean time series to the ERBE scanner global mean time series (Solar, LW, SW, and Net)